LIFE ON OTHER WORLDS?

A Resume of Present Ideas on the Subject—Draw Your Own Conclusions

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What is life? What power dictates where and under what conditions it can exist? No one knows the answer to that question, and because no one knows, it is only fair to take a liberal viewpoint concerning the matter. Plants breathe carbon dioxide and give off oxygen. Fish take oxygen from the water to sustain their lives. The animal and insect world live in a gaseous atmosphere of oxygen. It is not at all fair to bluntly state that life cannot exist in an atmosphere of ammonia or methane, or in any other substance for that matter. However, very few of us like to imagine any other kind of life than that to which we are accustomed. The foremost question is this: "Can life like **ours** exist on any of the other planets that we know about?" It is impossible to be certain, of course, for certainty can come only from direct observation. Maybe you would like to decide for yourself. Here are the facts as we see them. Weigh them for their value, add them up, put on a dash of imagination, and see what you conclude.

Altogether there have been nine planets discovered in our solar system. They are scattered through an area whose diameter is more than 7,000 million miles. The earth is less than a speck of dust in this vastness. But this is nothing in comparison with the size of the universe. There we find proportions far beyond the scope of human imagination. It is a seemingly unlimited sea of space in which even our whole solar system is but a grain of sand.

The first planet we shall investigate is Mercury. On the average it is about 35 million miles from the sun. Its diameter is approximately 3000 miles, less than half the diameter of the Earth. Because of its small size and also because its density is but 3.8, Mercury has a weak gravitation pull. Any particle with a velocity of 2.2 miles per second away from the planet would fly off never to return. Most gases have a molecular velocity greater than this at the temperature known to exist on one side of Mercury. As a result, Mercury has little if any atmosphere.

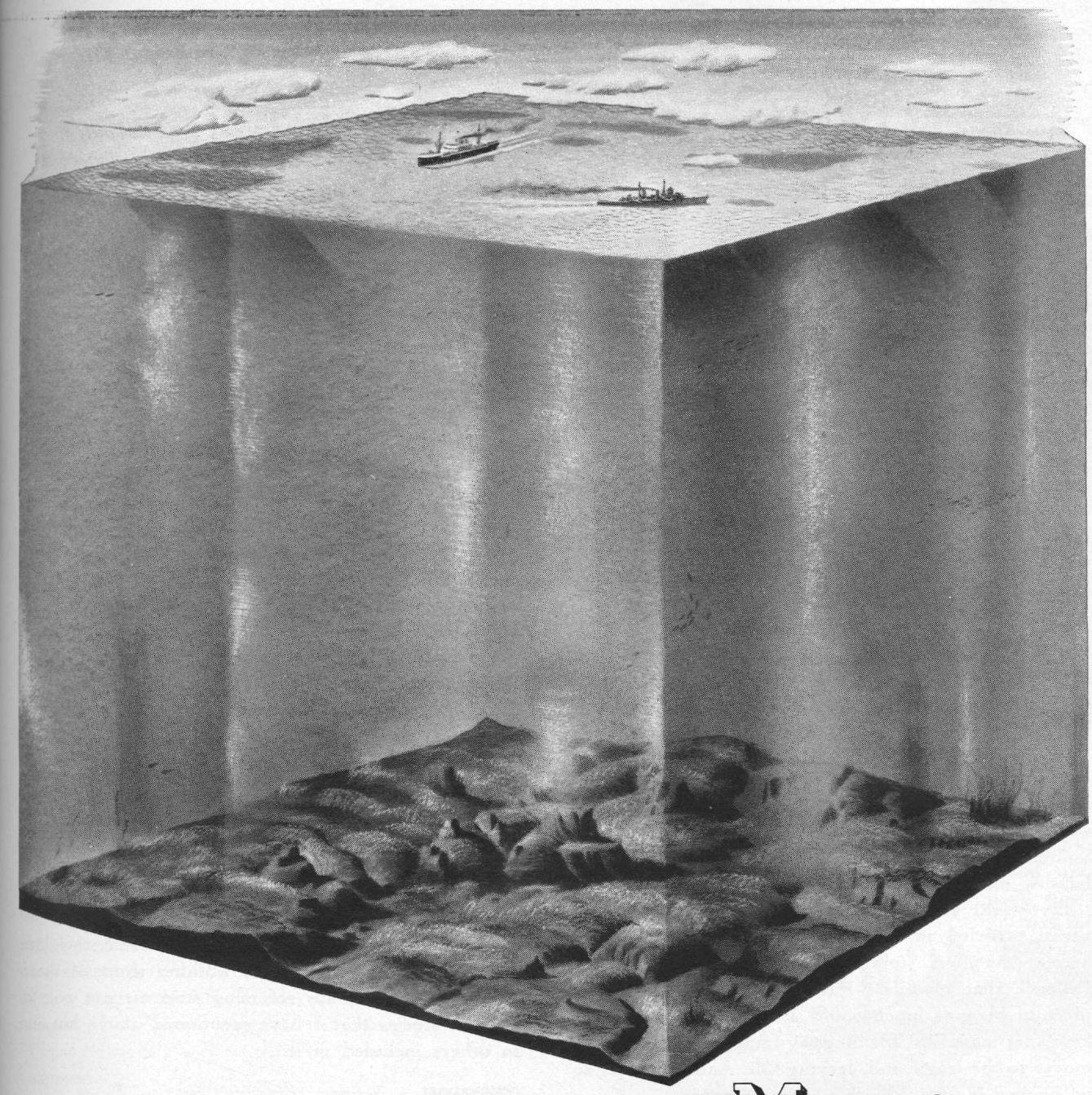
This small world has a period of axial rotation of 88 days which is the same period of time it takes to revolve once about the sun. Obviously then, Mercury always has the same hemisphere facing the sun. On one side of this planet, sulfur, lead, and bismuth would lie about in puddles, while on the other side almost every known substance would be frozen.

Venus is the next planet we shall examine. It is quite a bit farther from the sun than Mercury. Its average distance from the sun is roughly 67 million miles. Venus is of special interest because it is very nearly the size of the Earth. Its diameter is 7,700 miles as compared with the Earth's diameter, 7,918 miles. Then too, the densities of the planets are almost the same. We should expect to find, therefore, a sizeable atmosphere on Venus. This is quite true, a fact that is not questioned by any astronomer. One method of determining the extent of Venus' atmosphere is the comparison of photographs of it taken through infra-red light filters and ultra-violet light filters. An atmosphere turns back violet light while the red light has relatively little difficulty in penetrating most gases. We find the ultra-violet photograph to be slightly larger than the infra-red, and by measuring the difference in size, we can determine the thickness of the atmosphere. Venus has an atmosphere at least as deep, if not deeper than that on the Earth.

This is all very fine, but what are the constituents of this atmosphere? We turn to the spectroscope for our answer. Carbon dioxide seems to be in great abundance at the reflecting level of the atmosphere, and strangely, oxygen and water vapor cannot be found at all. If these elements are to be found at all on the planet, they must be located below the carbon dioxide. It would, however, be unreasonable to assume that oxygen, which is lighter than carbon dioxide, should be found below the carbon dioxide. Venus is always enveloped in a dense mass of clouds. The cause and composition of these clouds is still unknown. Many theories have been proposed to explain the clouds, but the question is still an open one.

According to the Mount Wilson Observatory, the temperature of the upper level of Venus' atmosphere is consistently—10° F. and is uniform all over the planet at this level. On the Earth, the temperature at a similar level is—67° F. At first, we might suppose that the average temperature on the surface of Venus would be much higher than that on the Earth because its upper atmosphere is so much warmer; however, it is entirely possible that the dense clouds might serve as a shield against the heat rays from the sun. Unfortunately, the clouds make it practically impossible to determine the period of axial rotation of the planet. The cloud layer is so thick that it obscures all markings on the surface. Ross, of Mount Wilson Observatory, has assigned a period of about thirty days based on his observation of "spots" he has seen on the planet. We must remember, however, that the temperature of the upper atmosphere is uni-

(*Continued on page* 20)



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Imagine trying to count up to nine billion! Yet that is the total you would have to reach if you counted every pound of magnesium that could be produced from a cubic mile of sea water.

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LIFE ON OTHER WORLDS?

(*Continued from page* 16)

form. Either very powerful winds circulate the atmosphere to maintain this temperature uniformity, or the period of thirty days is incorrect. We have no basis for denying either possibility.

On the whole, very little is known about Venus, and strange as it may seem this twin sister planet to the Earth comes within 25 million miles of our planet, closer than any other planet in the solar system.

It is hardly necessary to mention the Moon, for it is generally agreed that it is a world without an atmosphere and is subject to temperature extremes such as exist on Mercury. The Moon, of course, is a sattellite to the Earth and not a planet.

Mars, the most talked of planet in the solar system, makes its path in space at an average distance of 141 million miles from the sun, 49 million miles beyond the Earth. We know more about Mars than any other planet. Its diameter is 4,215 miles. Its density is about four-fifths that of the Earth. The velocity of escape on Mars is about 3 miles per second, while on the Earth, the velocity of escape is close to 7 miles per second. Obviously, Mars cannot have an atmosphere as extensive as ours, but it **has** an atmosphere constituted of life-essential elements. At the reflecting level of its atmosphere, there is 0.1 per cent as much oxygen and 5 per cent as much water vapor as there is in the Earth's atmosphere at sea level. We may reasonably assume that there is a greater amount of these substances in the lower levels of the Martian atmosphere. Of course, Mars has less of these life-important substances than the Earth, but it is quite possible that there is a sufficient amount of them to support some forms of life.

Mars is almost uncannily similar to the Earth in many physical respects. It has a period of axial rotation of 24 hours 37 minutes, only 41 minutes more than the Earth's period. Mars, then, has days and nights just as we find here on the Earth. It is almost more than remarkable that we should also find seasons on Mars similar to those on the Earth. Everyone knows that our seasons are the result of the sun's rays periodically shining more directly on one hemisphere for a longer time than on the opposite hemisphere. This phenomenon is due to the inclination of the Earth's axis at 23° 27′ to its orbit in conjunction with its revolution about the sun. Mars' axis is inclined at 23° 30′ to its orbit! However, since Mars' "year" or period of revolution about the sun is 687 days, the seasons on this planet are about twice as long as our seasons. Mars also has polar caps which disappear and reappear according to the seasons. Some astronomers believe that the white caps are frozen carbon dioxide. Others are convinced that they are ice or water vapor, at least.

Clouds have been observed on Mars up to 15 miles above its surface. They are not common, however, and Mars is practically cloudless. No seas have been found on Mars. It is thought to be a world whose surface is mainly desert land. The popular "canals" are still one of the great mysteries of Mars. Their existence is no longer disputed for they have been photographed by the Mount Wilson Observatory. According to the late Percival Lowell, the canals become visible and more recognizable simultaneously with the melting of the polar caps and the progression of the summer season. We immediately ask if the temperature on Mars is ever warm enough to melt ice; because if it were not, Lowell's observations and conclusions would be meaningless. Again Mount Wilson answers our question. The temperature on that part of the planet exposed directly to the sun's rays is found to be as much as 80° F. at times. As darkness comes over the planet, the temperature drops to many degrees below zero.

Most astronomers will agree that there is life on Mars or that it is more than just a possibility. The main reason is that as the summer approaches in a hemisphere, the surface begins to acquire a greenish tint in that part of the world. The green becomes more intense and darker as the summer progresses and the polar cap disappears. Then as winter comes on, the green changes to brown. That is convincing evidence for vegetable life, at least; but there have been alternate explanations for the color changes.

All of the preceding facts form an interesting combination which, no doubt, will be made even more interesting by the studies soon to be made with the new 200-inch telescope at Mount Palomar, California.

Of the remaining five planets, very little is known as far as the life-essential characteristics are concerned. The atmospheres of Jupiter, Saturn, Uranus, and Neptune are thought to contain a considerable amount of methane and ammonia. It is reasonable to assume that these planets are very cold because of their great distances from the sun. From Pluto, the most distant known planet, the sun would appear as little more than a very bright star. Incidentally, the only definite known fact about this remote planet is its period of revolution about the sun. Of the other planets just mentioned many of their basic physical properties are known, including density, size, oblateness, period of rotation, inclination of the axis, and period of revolution. However, any favorable conclusions regarding the possibility of life that may be drawn from these properties are greatly overshadowed by the constant reminder of the intense cold of outer space which envelops these last planets so far from the sun's life-giving rays.

There are the facts, as accurate and as true as modern science can give them to you. What do you think?